

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
12 July 2001 (12.07.2001)

PCT

(10) International Publication Number  
WO 01/50791 A2

(51) International Patent Classification<sup>7</sup>: H04Q 7/22

(21) International Application Number: PCT/FI01/00014

(22) International Filing Date: 5 January 2001 (05.01.2001)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:  
20000030 7 January 2000 (07.01.2000) FI

(71) Applicant (for all designated States except US): NOKIA NETWORKS OY [FI/FI]; P.O. Box 300, FIN-00045 Nokia Group (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): TARVAINEN, Tomi [FI/FI]; Keltarousku 8, FIN-02730 Espoo (FI). KROL,

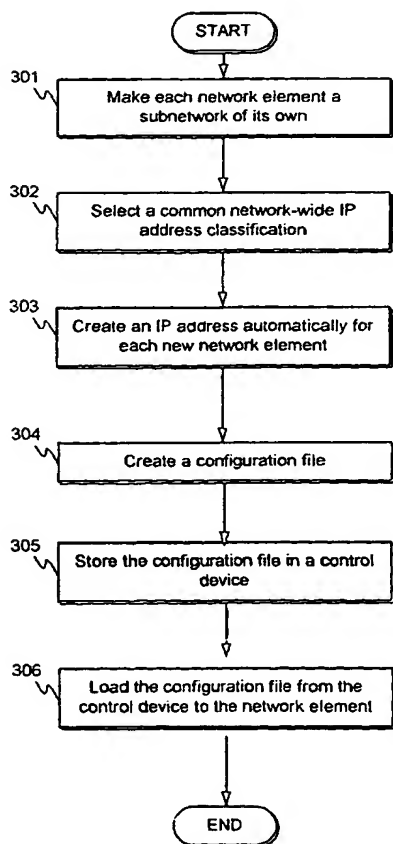
Jarek [PL/FI]; Matinraitti 7 H 107, FIN-02230 Espoo (FI). AUTIO, Kimmo [FI/US]; 1171 Lakeville Circle, Petaluma, CA 94954 (US). TORKKEL, Jari [FI/FI]; Rajatorpantie 11 B 13, FIN-01600 Vantaa (FI). PYYHTIÄ, Jarmo [FI/FI]; Mailatie 12 E, FIN-02180 Vantaa (FI). TUOMINEN, Hannu [FI/FI]; Forsellesintie 1-3 C 2, FIN-02700 Kauniainen (FI). OKKONEN, Juha [FI/FI]; Kirstinmäki 15 C 43, FIN-02760 Espoo (FI).

(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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(54) Title: METHOD FOR CONFIGURATING A BASE STATION NETWORK



(57) Abstract: This invention relates to telecommunication network planning and network control as well as to network installation procedures. In particular the invention relates to a method for configuring a telecommunication network, preparing a network element for operation, and giving an address to a network element, where each network element in the telecommunication network has an address of its own. The method according to the invention comprises the following steps in which each network element is made a subnetwork of its own (301), a common network-wide IP classification is selected (302), an IP address is created for each network element (303), a configuration file is created which comprises at least IP address information in combination with a network element site identifier (304), the said configuration file is stored in a control device (305), and the said configuration file is loaded from the control device into the network element on the basis of the site identifier (306). The invention further relates to a system for configuring a telecommunication network.



WO 01/50791 A2



(84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— Without international search report and to be republished upon receipt of that report.

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## Method for configuring a base station network

### FIELD OF THE INVENTION

This invention relates to telecommunication network planning and network control as well as to network installation procedures. In particular the invention relates to a method for configuring a telecommunication network, preparing a network element for operation, and giving an address to a network element, in which telecommunication network each network element has an address of its own.

### TECHNICAL BACKGROUND

A base station network in a mobile communication system comprises primarily base stations (BS) and a base station controller (BSC). The base station controller controls the operation of the base stations. The BSC is connected to a mobile switching center (MSC). The base stations provide connections to mobile phones through the air interface. The base stations are connected to the BSC through a radio link, copper cable or optical cable. Between the base stations and base station controllers there are usually cross-connects which take care of the switching of connections between the various devices. The tasks of the BSC include controlling the transmission power of mobile stations and carrying out handovers for mobile stations. The base station controllers are connected to a mobile switching center which handles the mobile telephone traffic in its geographical area. Its tasks include routing of calls, call management and termination of calls. Furthermore, the mobile switching center is connected to registers containing user information such as e.g. the home location register HLR and visitor location register VLR and a network management system NMS. Fig. 1 shows a block diagram of a typical base station network architecture. The base station network comprises base stations 10 and base station controllers 20. The base station controller 20 is connected to a mobile switching center MSC 30 in the mobile communication network. In addition, Fig. 1 shows mobile stations 5 connected to the base station network.

As the Internet gains more popularity, the technology involved, in particular the technology associated with IP (Internet Protocol) networks, has become cheaper and has been introduced in many fields of application. IP network technology is already being used in mobile communication systems as well, especially in setting up base station networks. In an IP network each device in the network has a unique address within the network. If a device has got several interfacing ports to the network, each

port is given an IP address of its own. There are two versions of the IP protocol. Version 4 of the IP protocol (IPv4) is specified in the document RFC 791. Version 6 of the IP protocol (IPv6) is specified in the document RFC 1883.

5 An IPv4 address consists of a string of 32 bits. Fig. 2 illustrates the structure of IPv4 address. IPv4 addresses are currently divided into five classes: A, B, C, D and E. The most significant bits in the address indicate the class of the address. A, B and C class IP addresses are divided into two parts: the net part and the host part. The net part identifies the network to which the host is connected, and the host part identifies the host's connection port to the network. By reserving more bits to the net part and fewer bits to the host part it is possible to assign addresses to an overall network architecture comprising a large number of discrete networks. Such a case of course involves the restriction that a discrete network cannot contain very many recipients. Conversely, if we have a few large networks with a large number of users in them, then it is best to choose a net part comprising fewer bits and a host part comprising many bits. A D-class address comprises a so-called multicast address, and class E is reserved for future use. IP addresses are unique, so granting and assigning IP addresses must be supervised so that one and the same address not be given more than once.

20 A new device attached to an IP network needs an IP address of its own. A popular way to implement the allocation of an IP address to a new device attached to the network is to have the new device request the IP address from a DHCP (Dynamic Host Configuration Protocol) server or BOOTP (Bootstrap Protocol) server either in the same or in a different network. The DHCP server keeps track, in a centralized manner, of the IP addresses required by a network in the geographical area assigned to it. The DHCP or BOOTP server allocates the new device a free IP address and sends information about it to the new device. As soon as the new device has got an IP address, it is able to communicate in the network. Another alternative, somewhat more complicated though, is to program an IP address for the new device already before it is delivered to its final destination, but this calls for very careful network planning and maintenance.

35 If the network topology is such that a router is connected to an outside network via one route only and to the internal network hierarchy via multiple ports, then the network elements connected to each one of the ports can be regarded as discrete subnetworks. Therefore, a so-called subnetwork mask can be used in the IP addresses. Subnetwork mask means that the host part of the IP address is divided into two parts: a part specifying the subnetwork and the host part proper. Thus,

when the subnetwork is being implemented, the IP addresses in the subnetwork can be compiled such that the combination of the part specifying the subnetwork and the net part proper is considered the internal net part of the subnetwork.

5 In order to make network planning easier, the base station network can be divided into subnetworks which are planned separately. A subnetwork may consist of e.g. several base stations located in one and the same geographical area. In addition, a so called DCN (Data Communication Network) for the subnetwork has to be set up for the purpose of network control. Subnetwork planning is usually quite a laborious and time-consuming phase in network planning.

10 If human errors such as incorrectly installed cross-connections, incorrectly positioned radio links etc. occurred during the installation of a network, a connection to a DHCP or BOOTP server cannot be established. Such errors in the installation stage of the network are quite usual due to e.g. differing installation schedules of the various parts of network. A new device must also be provided with a connection to  
15 the network control system, whereby this, too, is made uncertain by the factors mentioned above. Therefore, an easier base station installation method is needed.

#### SUMMARY OF THE INVENTION

An object of the invention is to provide an installation method for base station network elements, eliminating the disadvantages mentioned above. Another object of  
20 the invention is to provide an installation method for base station network elements which simplifies the installation of a base station network based on an IP communication network.

The objects of the invention are achieved by arranging for a special installation file specifying the parameters for the element to be installed, which parameters can be  
25 loaded into the network element on-site. A correct installation file can be stored for the correct network element on the basis of predetermined criteria.

The method according to the invention for configuring a telecommunication network, preparing a network element for operation and giving an address to a network element, in which telecommunication network each network element has an address  
30 of its own, is characterized in that the method comprises steps in which

- each network element is made a subnetwork of its own (301),
- a common network-wide IP classification is selected (302),

- an IP address is created for each network element (303),
- a configuration file is created which comprises at least IP address information in combination with a network element site identifier (304),
- the said configuration file is stored in a control device (305), and
- 5 - the said configuration file is loaded from the control device into the network element on the basis of the site identifier (306).

The system according to the invention for configuring a telecommunication network, preparing a network element for operation and giving an address to a network element, in which telecommunication network each network element has an address  
10 of its own, is characterized in that the system comprises

- means (401) for selecting a common network-wide IP classification and for making each network element a subnetwork of its own,
- means (402) for creating IP addresses for the network elements,
- means (403) for creating a configuration file which comprises at least IP address  
15 information in combination with a network element site identifier,
- means (404) for storing the said configuration file in a control device, and
- means (405) for reading the said configuration file from the control device into a network element on the basis of the site identifier.

Advantageous embodiments of the invention are presented in the dependent claims.

- 20 The method according to the invention utilizes advantageously a predetermined, fixed and network-wide subnetwork mask. Furthermore, each node in the network is regarded in the method according to the invention as a subnetwork of its own so that each individual network element can be given a unique IP address. In accordance with the method according to the invention, a site identifier is created for each network element, on the basis of which site identifier the new network element can be  
25 transported to its place of installation and the right configuration file can be selected in the control device in the installation phase. By means of the method according to the invention it is possible to automatically configure the base station network to be installed. The telecommunication system according to the invention comprises  
30 the means with which the method described above can be implemented.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is below described more closely with reference to the accompanying drawings in which

Fig. 1 shows an example of a typical base station network,

5 Fig. 2 illustrates the structure of IP addresses,

Fig. 3 shows a flow diagram according to a preferred embodiment of the invention,

Fig. 4 shows a telecommunication system according to the invention, and

Fig. 5 shows a control device according to the invention.

10 Like elements in the drawings are denoted by like reference designators. Figs. 1 and 2 were already discussed above in conjunction with the description of the prior art.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Let us first consider the network planning and set-up process in general outline. At the initial stage, the necessary preliminary studies and measurements are carried out  
15 in the area where the network is to be installed. Also at the initial stage, planning is done regarding the required radio links, capacities and other things essential to radio communication connections. After various planning processes, the data are delivered to a factory where the necessary network elements are compiled in order to build a radio network according to the plan.

20 As is known, every network element handling data traffic needs an IP address by which it can be identified. IP address generation can be realized by a specially designed element, for example. Such an element is called a generating element, for instance. The generating element comprises a means with which it can produce IP addresses such that no two network elements are given the same IP address. Correspondingly, a so-called site identifier, or site ID, is generated for each device to be  
25 built, by means of which site ID the network elements built can be transported to their correct locations. The site ID may be e.g. a sequence of digits giving the correct location information for the network element, whereby the device in question can be transported to the right location. According to another preferred  
30 embodiment the said site ID may simply comprise the coordinates for the geographical location of the network element in question. Advantageously the installer

of the network element stores the said IP address and site ID in a control device such as a portable computer used for on-site network element installation. Advantageously the said information is stored e.g. in a so-called configuration file which is uploaded to the network element on the site.

- 5 In applying the solution according to the invention it is advantageously required that each network node is a subnetwork of its own. In this exemplary embodiment this means that each one of the network cross-connects through which the base stations BS are connected to the base station controller BSC, constitutes a subnetwork of its own. Since each cross-connect functions as a router, a routing protocol can be used  
10 between the cross-connects. Moreover, the arrangement described has the advantage that, as far as address generation is concerned, it suffices that each subnetwork is configured uniquely, i.e. so that each network element in the subnetwork has an IP address of its own.

- Another thing to observe in applying the solution according to the invention is that  
15 the whole network conforms to a common standard subnetwork mask. This means that the IP addresses in the network are in accordance with a certain predetermined structure. The IP address structure is selected on the basis of subnetwork size. Enough bits are reserved for the net part and host part of the IP address so that each network element can be given a unique IP address.

- 20 It is obvious to a person skilled in the art that since every network node advantageously functions as a subnetwork of its own and since the network has a common subnetwork mask, the router network can be set up, whereby individual network elements can start operating, as soon as the link connections between the different sets of devices are established. This arrangement according to the invention brings  
25 the advantage that the only thing to observe in the network planning is that every network node is given an unequivocal network identifier. An unequivocal network identifier means a network identifier which is unique within the whole network.

- Let us next consider the method according to the invention shown in Fig. 3 for  
30 connecting a new network element, such as a cross-connect or base station BS, to an existing network. A principal idea of the invention is that each network element is set up as a subnetwork of its own 301. Another principal idea of the invention is that a common IP address classification is selected for the network 302. Next, the network element is given a unique IP address 303 which is stored together with other information in a configuration file 304. The configuration file advantageously com-  
35 prises a site ID by means of which the configuration file of each new network ele-



ment can be loaded into the right network element. Advantageously the IP address and site ID are created automatically. After planning and generation, the said configuration file is transferred to a so-called control device 305, meaning a device where the installer has stored all the configuration files for all the different network elements and which control device can be connected to the new network element for uploading the data. The installer of the network element loads the configuration file into the new network element by means of the control device on the site of the new network element 306. The correct file is advantageously selected on the basis of the site ID. It is obvious to a person skilled in the art that the said network element may be any element in a telecommunication network. Especially advantageously it is a base station BS.

It is obvious to a person skilled in the art that using the arrangement according to the invention in which each network element is a subnetwork of its own and the whole network has a common subnetwork mask, one can avoid one of the most laborious stages in network planning, i.e. subnetwork DCN planning, where the DCN network is used in network control.

One of the consequences of the arrangement according to the invention is that possible errors made in the installation phase of a network element will not prevent the setting up of the network element. As the network element can be brought into operating condition completely without radio communication, the installation of the network element can be completed even if not all network portions of the network in question are functioning when the network element is being installed.

A telecommunication system according to the invention comprises means for setting up a network element and giving an address to a network element. Fig. 4 shows a system according to a preferred embodiment, comprising in its entirety a first means 401 to select a common network-wide IP classification and to make each network element a subnetwork of its own. After the IP-classification the system comprises a second means 402 for creating an individual IP address for every network element. After the IP address generation, the system generates a configuration file using a means 403 intended for this purpose. A configuration file advantageously comprises the IP address of a given network element together with the geographical location data for the network element in question. A telecommunication system according to the invention further comprises a means 404 by which the said configuration file can be stored in a control device. The system also comprises a means 405 for reading the configuration file from the control device into the network element on the basis of the geographical location data. It is obvious to a

person skilled in the art that the means described above can be regarded as software arranged so as to be loaded into a microprocessor in order to implement the functions of the means described above.

Let us next consider a control device according to the invention shown in Fig. 5 which is used to convey the configuration file to the element to be installed. The control device advantageously comprises a means 501 by which the configuration file, which was created in the network planning phase, can be stored in a control device. Advantageously the control device comprises a means 502 where the said configuration files can be stored. Such a means may comprise e.g. a memory circuit in the control device. In addition the control device comprises a means 503 by which the configuration file stored therein can be transferred to the network element to be installed. The control device may also be adapted so as to include a means by which the geographical location of the control device can be determined automatically. This is of particular advantage in a situation where the site ID directly comprises the geographical coordinates of the new network element. The configuration file to be loaded into the network element has been stored in the control device on the basis of the geographical coordinates, so automatic geographical positioning of the control device can be used especially advantageously to find the correct configuration file for the network element. The geographical positioning may be realized using either an integrated or separate GPS (Global Positioning System) device, for example. Control devices suitable for the arrangement according to the invention may include e.g. a portable personal computer or a PDA (Personal Digital Assistant) or some other similar device comprising the means described above. It is obvious to a person skilled in the art that the configuration file may be loaded into the network element also through a mobile station or the like. This naturally requires that in the place where the new network element is being installed, there must already exist the preconditions for radio communication or that the mobile station has enough memory capacity for storing the configuration files. If the control device is a mobile station and the configuration files are sent to the control device by radio, the mobile station is arranged, if necessary, to utilize another radio network system operating in the same area to receive the configuration file when the network, which is being set up, is not yet functioning.

Advantageously the configuration file contains the information required by the new element in order to set it up in the network. Especially advantageously the file combines the site ID of the new element with the IP address of the network element. As soon as the configuration file is stored in the network element, the network element

is ready to communicate with other existing network elements, for it has got an IP address of its own. The method described has also the advantage that even if there is no control channel at the time of installing the element, the installation can be completed and, moreover, without error messages, for as the new element also functions  
5 as a router, it is able to update its files according to changes in the surrounding network. A control channel can be established for the network element at the latest when a permanent connection is established for the element via the network.

The method according to the invention involves several other advantages, too. For example, in base station network planning there is no need for separate planning for  
10 IP network addresses and other parameters since they can be created automatically as each network element forms a subnetwork of its own. Moreover, since a predetermined class is used for the IP addresses, difficult and time-consuming subnetwork planning is avoided and existing IP routing procedures for the class in question can be used. The base station network to be installed starts operating as an  
15 IP network with all the usual IP network functions as soon as at least two elements are interconnected. This, in turn, simplifies testing and diagnostics considerably.

It is obvious to a person skilled in the art that network planning and the method according to the invention can be realized e.g. within a network management system (NMS). This makes network management and maintenance easier. The  
20 method may also be realized in network planning stages other than those mentioned here by way of example. Especially it is obvious that the method according to the invention is primarily meant to be used in private IP networks.

The method according to the invention can be used both in networks based on the IPv4 and in networks based on the IPv6 protocol. Moreover, the method according  
25 to the invention for installing an element in a base station network can be applied in the GSM (Global System for Mobile communications), UMTS (Universal Mobile Telecommunication System) and other digital mobile communication systems in which an IP network can be used as a communications network of the base station network.

30 The name of a given functional unit, such as base station controller, is often different in different cellular network systems. For example, in the UMTS the functional unit equivalent to the base station controller (BSC) is the radio network controller (RNC). Therefore, the terminology in this application as regards network elements is, for reasons of clarity, in accordance with the GSM system, but the  
35 invention is not limited solely to the GSM system.

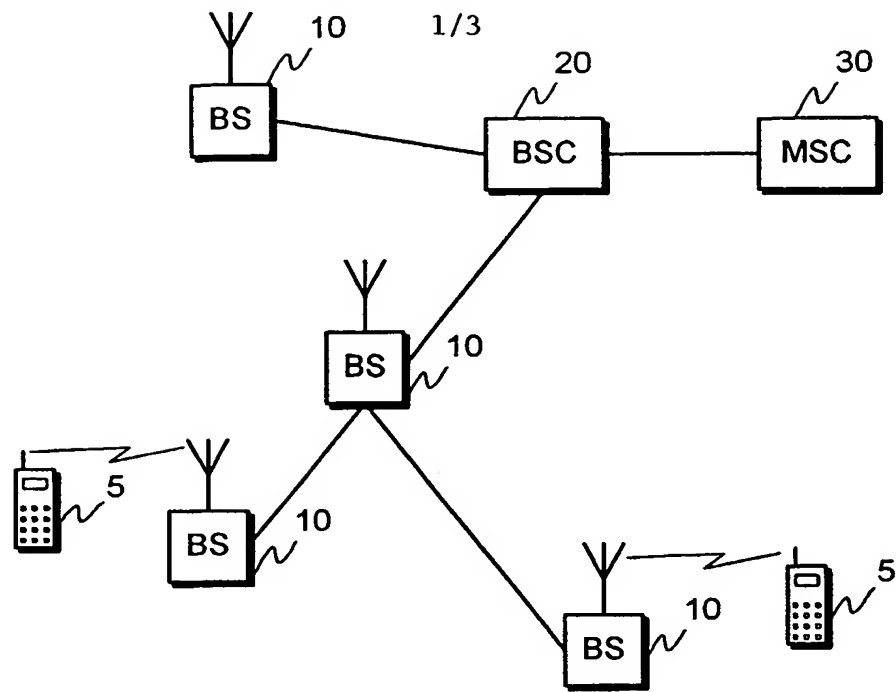
In view of the foregoing it is obvious to a person skilled in the art that various modifications can be made without departing from the scope of the invention. Although an advantageous embodiment of the invention was described in detail, it is obvious that various modifications to and variations on the embodiment are possible, which  
5 modifications and variations are in accordance with the true spirit and scope of the invention.

**Claims**

1. A method for configuring a telecommunication network, preparing a network element for operation and for giving an address to a network element, in which telecommunication network every network element has an address of its own, characterized in that the method comprises steps in which
  - each network element is made a subnetwork of its own (301),
  - a common network-wide IP classification is selected (302),
  - an IP address is created for each network element (303),
  - a configuration file is created which comprises at least IP address information in combination with a network element site identifier (304),
  - the said configuration file is stored in a control device (305), and
  - the said configuration file is loaded from the control device into the network element on the basis of the site identifier (306).
2. A method according to claim 1, characterized in that the IP address is created for each network element automatically.
3. A method according to claim 1, characterized in that the said site identifier comprises a sequence of symbols.
4. A method according to claim 1, characterized in that the site identifier comprises the geographical coordinates of the new network element.
5. A system for configuring a telecommunication network, preparing a network element for operation and giving an address to a network element, where each network element in the telecommunication network has an address of its own, characterized in that the system comprises
  - means (401) for selecting a common network-wide IP classification and for making each network element a subnetwork of its own,
  - means (402) for creating IP addresses for the network elements,
  - means (403) for creating a configuration file which comprises at least IP address information in combination with a network element site identifier,

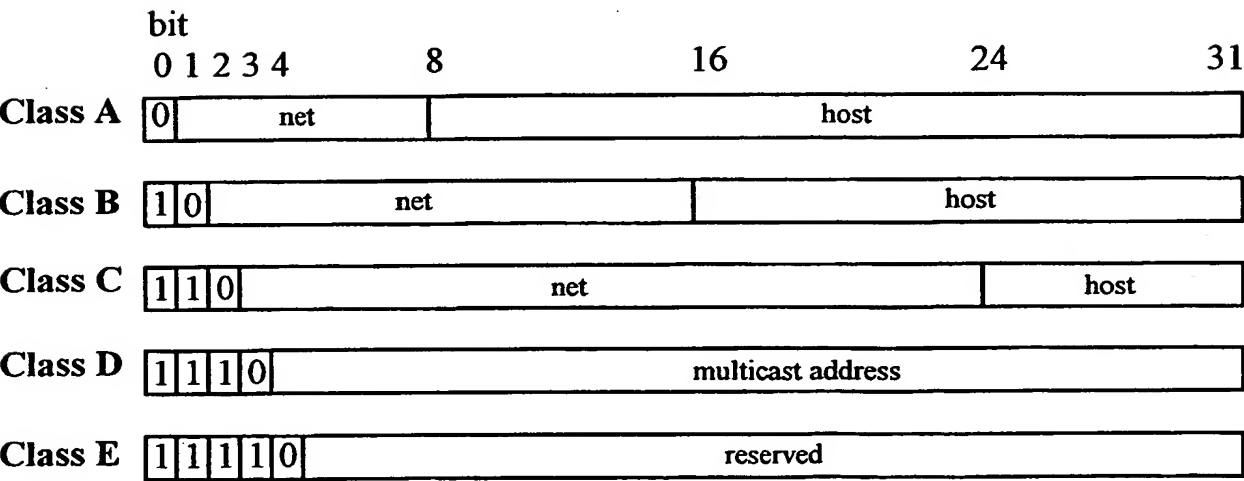
- means (404) for storing the said configuration file in a control device, and
- means (405) for reading the said configuration file from the control device into a network element on the basis of the site identifier.

- 5 6. A system according to claim 5, characterized in that the said network element is a base station.
7. A system according to claim 5, characterized in that the said control device is a computer.
8. A system according to claim 5, characterized in that the said control device is a so-called personal digital assistant.
- 10 9. A system according to claim 5, characterized in that the said control device is a mobile station.



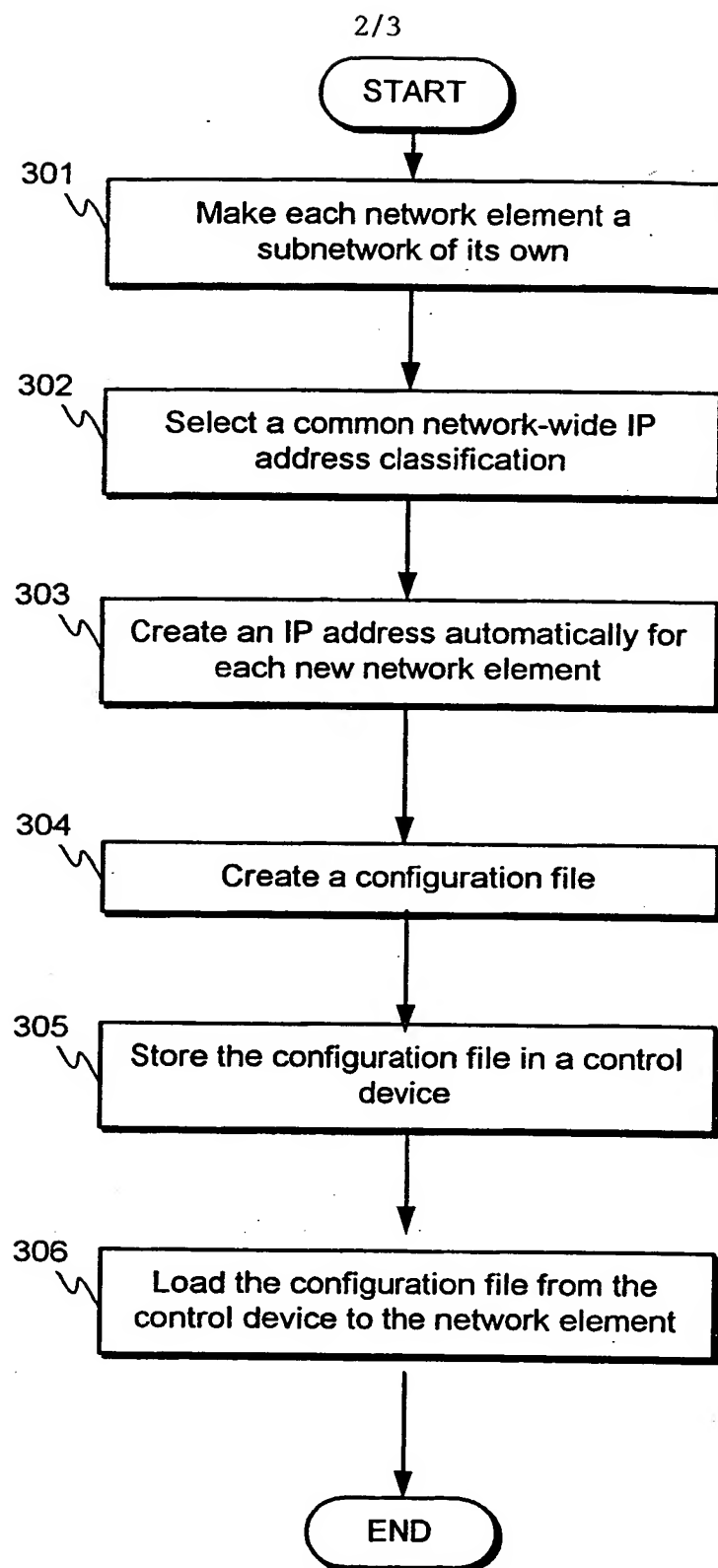
PRIOR ART

Fig. 1



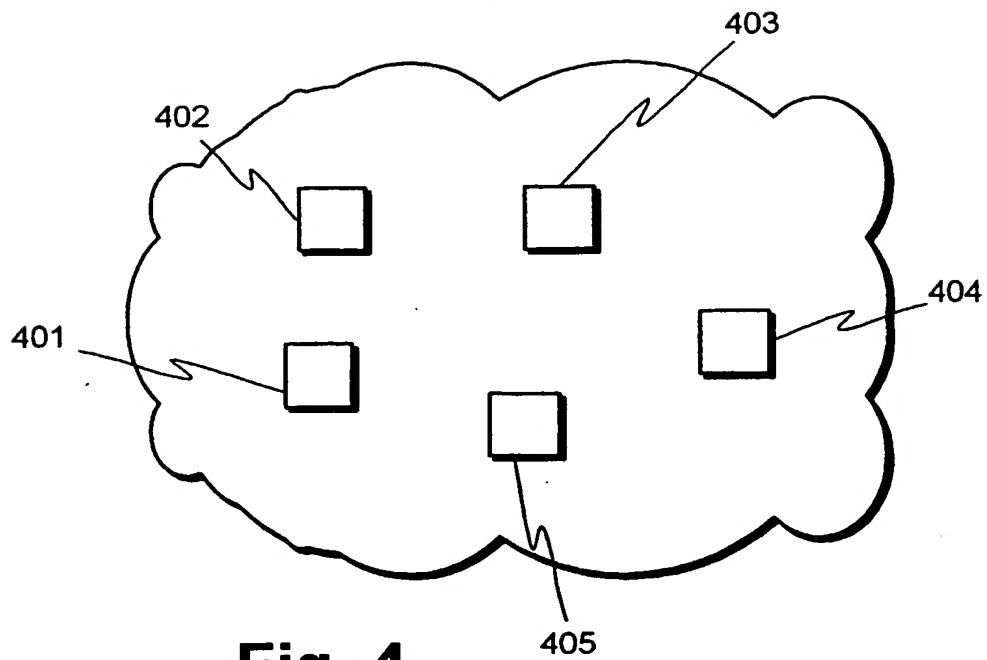
PRIOR ART

Fig. 2

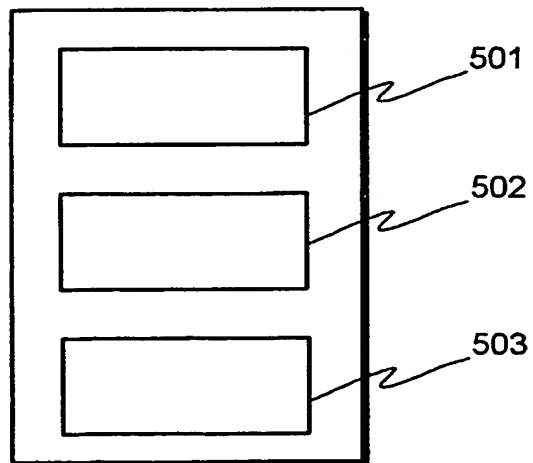
**Fig. 3**



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**Fig. 4**



**Fig. 5**



(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
12 July 2001 (12.07.2001)

PCT

(10) International Publication Number  
WO 01/50791 A3

(51) International Patent Classification<sup>7</sup>: H04Q 7/34

(21) International Application Number: PCT/FI01/00014

(22) International Filing Date: 5 January 2001 (05.01.2001)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:  
20000030 7 January 2000 (07.01.2000) FI

(71) Applicant (for all designated States except US): NOKIA CORPORATION [FI/FI]: Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): TARVAINEN, Tomi [FI/FI]: Keltarousku 8, FIN-02730 Espoo (FI). KRÖL,

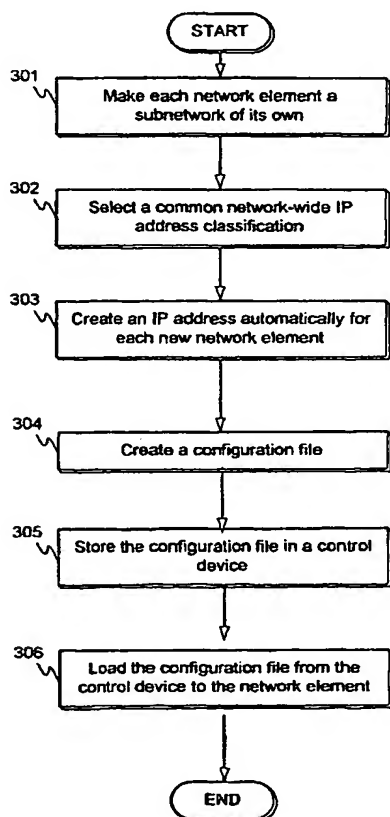
Jarek [PL/FI]: Matinraitti 7 H 107, FIN-02230 Espoo (FI). AUTIO, Kimmo [FI/US]: 1171 Lakeville Circle, Petaluma, CA 94954 (US). TORKKEL, Jari [FI/FI]: Rajatorpantie 11 B 13, FIN-01600 Vantaa (FI). PYYHTIÄ, Jarmo [FI/FI]: Mailatie 12 E, FIN-02180 Vantaa (FI). TUOMINEN, Hannu [FI/FI]: Forsellesintie 1-3 C 2, FIN-02700 Kauniainen (FI). OKKONEN, Juha [FI/FI]: Kirstinmäki 15 C 43, FIN-02760 Espoo (FI).

(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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(54) Title: METHOD FOR CONFIGURATING A BASE STATION NETWORK



(57) Abstract: This invention relates to telecommunication network planning and network control as well as to network installation procedures. In particular the invention relates to a method for configuring a telecommunication network, preparing a network element for operation, and giving an address to a network element, where each network element in the telecommunication network has an address of its own. The method according to the invention comprises the following steps in which each network element is made a sub-network of its own (301), a common network-wide IP classification is selected (302), an IP address is created for each network element (303), a configuration file is created which comprises at least IP address information in combination with a network element site identifier (304), the said configuration file is stored in a control device (305), and the said configuration file is loaded from the control device into the network element on the basis of the site identifier (306). The invention further relates to a system for configuring a telecommunication network.



WO 01/50791 A3



**(84) Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**(88) Date of publication of the international search report:**  
10 January 2002

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

— with international search report

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 01/00014

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/34

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 9922541 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 6 May 1999 (06.05.99), page 7, line 10 - line 20; page 10, line 14 - line 19 --	1-9
Y	WO 9943174 A1 (QUALCOMM INCORPORATED), 26 August 1999 (26.08.99), page 7, line 29 - page 8, line 2; page 8, line 15 - line 21 -----	1-9

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

2 July 2001

Date of mailing of the international search report

04-07-2001

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Tomas Erlandsson/MN  
Telephone No. +46 8 782 25 00

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

28/05/01

International application No.  
PCT/FI 01/00014

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
WO	9922541	A1	06/05/99	AU	9657798 A	17/05/99
				CN	1286003 T	28/02/01
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				BR	9908159 A	07/11/00
				CA	2258912 A	19/11/98
				CN	1292205 T	18/04/01
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				EP	1057354 A	06/12/00
				US	6161439 A	19/12/00
				WO	9851546 A	19/11/98
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